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**Southwestern
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Forest Pest Management Report

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FOREST INSECT AND DISEASE CONDITIONS
IN THE
SOUTHWESTERN REGION

1994

APRIL 1995

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USDA Forest Service, Southwestern Region

State and Private Forestry

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Introduction

This report summarizes the status of insects and diseases in the forests of the Southwest. Much of the insect information is based on aerial detection surveys. Most of the disease information is based on ground observations and surveys.

The report also includes brief descriptions of other entomology and pathology activities in the Region in 1994. Included is a discussion on pest management and ecosystem management.

Much of the information on State and private lands was contributed by Robert Cain, Extension Forest Entomologist, New Mexico State University Cooperative Extension Service; and Robert Celaya, Forest Pest Specialist, Arizona State Land Department.

Summary of Insect and Disease Activity in 1994

A major outbreak of bark beetles affecting ponderosa pine continued for the fourth consecutive year on the Lincoln National Forest and Mescalero-Apache Indian Reservation (Sacramento Mountains) in southern New Mexico. Mortality was determined on approximately 22,710 acres in 1994, compared with 32,120 acres in 1993. This outbreak consists primarily of the roundheaded pine beetle, with other species active in some locations. A similar, but smaller outbreak continued on the Coronado National Forest (Pinaleno Mountains) in southwest Arizona, affecting about 2,130 acres in 1994.

Bark beetle activity remained relatively low in other parts of the Southwest. Regionwide, the total area affected by bark beetles in 1994 was estimated to be 37,730 acres, down slightly from the previous year.

Western spruce budworm defoliation increased considerably, from 66,400 acres in 1993 to 369,170 acres in 1994. This outbreak occurs throughout much of the mixed-conifer forests of northern New Mexico. No budworm defoliation was detected by aerial surveys in Arizona or southern New Mexico.

Approximately 9,030 acres of defoliated aspen were detected in 1994, down from 17,220 acres in 1993. This damage occurred at several locations throughout the Region, and was caused by a combination of the large aspen tortrix, western tent caterpillar, marsonina leaf blight, and abiotic factors.

Dwarf mistletoe infection occurs in over two million acres of commercial timberland in the Region, and causes an estimated 25 million cubic foot growth loss annually. The overall incidence changes little from year to year, but is thought to have gradually increased during this century.

Root diseases are also widespread and chronic, causing an estimated 5 million cubic foot annual growth loss. Armillaria and annosus are the most common root diseases in the Southwest. Generally, incidence is higher in mixed-conifer and spruce-fir forests than in pine.

White pine blister rust occurs throughout most of the range of southwestern white pine in the Sacramento and White Mountains of southern New Mexico. In 1994, it was confirmed for the first time in the nearby Capitan Mountains. It has not been detected elsewhere in the Region.

Pest Management and Ecosystem Management

It has long been recognized that insects and diseases can be important "**agents of change**" in the forest. For decades, we (pest specialists, land managers, et. al.) have keyed in on the **damage** caused by forest insects and pathogens. We have attempted to quantify the damage (volume lost, trees killed, acres infected, etc.) with various types of surveys. Then, to a greater or lesser extent, we have attempted to reduce the damage.

Often, the emphasis has been on direct control (suppression) of the insect or pathogen, i.e. pest. Control measures have included spraying defoliating insects and removing trees infected with dwarf mistletoe or recently attacked by bark beetles. The approach is fairly simple and straight-forward: **following the detection of a pest, measures might be taken to suppress it.**

We might call this the "flyswatter" method of control. Although there may be nothing inherently wrong with this approach, sometimes it is too simplistic, especially in forest situations. Sometimes it is difficult to tell how effective suppression will be, especially over the long-term. Populations of insects and pathogens, in part because of their ability to multiply rapidly, are remarkably well-adapted for survival and can be very difficult to control. Then too, the suppression activity itself, e.g. clearcutting, may have damaging effects of its own.

Nevertheless, there are still some situations when direct control measures seem prudent and justified. For example, if a population of gypsy moths, an exotic pest, were detected in the southwest, suppression measures to eliminate this potentially damaging insect should be seriously considered. Some dwarf mistletoe suppression activities are appropriate and can have long-term benefits.

Another approach to reducing forest insect and disease damage is **prevention**. There are many types of prevention activities that we've used successfully in the past and should continue to use in the future. Thinning overcrowded forests appears to be an effective way to prevent damage from several types of bark beetles. Thinning can be effective in limiting spruce budworm damage, especially by reducing the "ladder effect" and by favoring non-host species. Young conifer regeneration can often be protected from dwarf mistletoe infection by the timely removal (or killing) of infected seed-trees or residuals.

In general, **appropriate thinning increases the vigor of the remaining trees and reduces their susceptibility to certain insect and disease damages.** And certainly the prevention of insect and disease damage is just one benefit from thinning a crowded forest, whether we are considering **individual trees, a stand, or an entire landscape.**

We believe that attention should and will continue to be given to limiting damage from forest insects and diseases as we move into ecosystem management. At the same time, it is important that we take a more "holistic" look at insects and pathogens long

considered "forest pests" for a better understanding of their **ecological roles**. The beneficial roles of certain forest insects and diseases–their role in nutrient cycling, for example–have long been recognized. Over the past year, we've changed the name of our working group to "**Entomology and Pathology**" to reflect our broader interests and perspectives.

The Matter of Scale

The concept of "scale" is a major framework in the current approach to ecosystem management. Decisions are to involve analysis at multiple scales, with more emphasis placed on analysis of larger geographical areas using such tools as GIS.

How will insect and disease information be incorporated into this type of decision making? Our Regionwide aerial detection surveys will summarize major insect activity for the entire Southwest, as well as at the Forest and District levels. Specific locations of affected areas across a landscape will be available, on maps and in data bases. Some historical information, based on previous surveys, should be available.

Our ability to alter a forest landscape toward a desired condition depends upon treatments of smaller areas traditionally called stands. While analysis at broader scales may be important, there is no substitute for good stand information, particularly "on the ground" knowledge, when treatments are being considered. Selection and marking greatly affect the outcome of treatments, and ultimately, what the forest will look like long into the future.

Our staff is available to assist with on the ground evaluations of insect and disease conditions in the forest, as well as to provide input at other levels of the decision making process.

Adaptive Management

Our approach toward the management of forest insects and diseases has continued to change with new information and new ideas. No aerial spraying has been done for control of spruce budworm or other insects in the Region for several years. We have taken a closer look at dwarf mistletoe suppression efforts and have modified our approach. Gene conservation efforts may play a role in our management of southwestern white pine, now affected by white pine blister rust, an exotic disease.

Forest Health

Over the years, particularly the last few, there has been much discussion (and some concern expressed) about the "health" of our Western Forests. Catastrophic wildfires, insect outbreaks, chronic disease situations, and many other situations all suggest that the condition of our forests is less than ideal.

Nevertheless, we realize that some "disturbances" are normal in the functioning of a forest. Ideally, then, we might **attempt** to manage the forest to maintain insects and diseases within their "natural ranges of variability." Unfortunately, we are far from determining what these ranges are.

The loss of significant amounts of aspen and high elevation ponderosa pine, what appear to be an increases in the incidence of dwarf mistletoes, and the introduction of exotic pests such as white pine blister rust are among our concerns with the condition of Southwestern forests.

Evidence from many parts of the Western U.S. indicates that there have been significant changes in the structures of our forests, particularly in the ponderosa pine type, since pre-European settlement. While "pre-settlement" conditions may not be "desired" conditions (or feasible to achieve over large areas) they should provide us much insight.

Many of us believe that the most significant "forest health problem," and the condition that can most easily be addressed, is that there are simply **too many trees in the forest–primarily small and mid-sized trees–resulting in poor growth and vigor.** The development of other vegetation is often inhibited; the risk of catastrophic wildfire relatively high.

While there is still much to be learned about insects, diseases, other disturbance agents, and ecosystem function in general, given what we already know, it appears there is more we could be doing to improve the condition of our forests.

Insect and Disease Highlights in 1994

Dwarf Mistletoes *Arceuthobium* spp.

Dwarf mistletoes are the most significant disease-causing agents in the forests of the Southwest. The impact of these parasitic plants on timber production has been recognized for decades, and much attention has been focussed on attempting to control them through silviculture. Recently, more attention has been given to the fact that dwarf mistletoes are a natural component of our forests, and that they provide benefits to some species of wildlife.

The most widespread species of dwarf mistletoe in the Southwest are *A. vaginatum* subsp. *cryptopodum* on ponderosa pine, *A. douglasii* on Douglas-fir, and *A. divaricatum* on pinyon pine. Several other species occur on other conifer hosts. Over two million acres of commercial forest in the Region have some level of infection; several hundred thousand additional infected acres occur in noncommercial and reserved areas, woodlands, and other public and private forest lands.

There is some evidence that the incidence of dwarf mistletoe has increased during this century. Several decades of fire suppression is thought to be a major reason in the increase, since fire was probably the main factor that kept the parasite in check in the past. Selective cutting has probably also contributed to the increase. It seems very likely that increases in dwarf mistletoe populations have occurred simultaneously with the changes in forest conditions since European settlement, especially in the ponderosa pine type.

Data from several ponderosa pine stands treated to control dwarf mistletoe indicate that infection levels typically return to pre-treatment levels within twenty years. While appropriate cutting can help keep the disease in check, inappropriate cutting practices can result in increases in the spread and intensification of the parasite. Prescribed burning may help control dwarf mistletoe in some situations.

Western Spruce Budworm *Choristoneura occidentalis*

A very extensive outbreak of western spruce budworm has developed in northern New Mexico. Defoliation began to increase in 1993, and expanded greatly in 1994. Acres with light to heavy defoliation, as seen during aerial detection surveys in 1994 are as follows:

Carson NF	245,230	Jemez Indian Res.	2,720
Santa Fe NF	23,040	Picuris IR	1,160
Cibola NF	7,320	Santa Clara IR	2,440
		Taos IR	15,080

State & Private lands 72,180

Total 369,170 acres

Defoliated acres on the Carson National Forest increased about twenty-fold, from 11,720 acres in 1993, while there was only a slight increase on the Santa Fe National Forest. Most areas showed substantial increases over 1993 levels.

The actual area affected by the outbreak may be considerably more than these figures indicate, since areas with very light defoliation cannot be detected from the air.

Interestingly, very little budworm defoliation was detected by aerial survey in the forests of southern New Mexico, and none in Arizona, in 1994.

Budworm larvae feed on the new, current year's foliage of true firs, Douglas-fir, and spruce. Repeated years of defoliation can cause mortality or topkill. Although outbreaks are unsightly and cause growth loss and damage, they also serve as natural thinning agents and play a role in nutrient cycling. In some areas, outbreaks tend to promote non-host species, particularly ponderosa pine, affecting species composition.

Budworm outbreaks are a natural phenomenon in the mixed-conifer forests of the southwest. However, with increases in the amount of white fir and Douglas-fir over the last century, due to fire suppression and the harvest of pine, outbreaks may well be more severe than previously.

Roundheaded Pine Beetle *Dendroctonus adjunctus*

Two outbreaks of this bark beetle continued in 1994, a major one in the Sacramento Mountains of southern New Mexico, and a smaller, but significant one in the Pinaleno Mountains of southeastern Arizona. Roughly 25,600 trees were killed on the Mescalero Apache Indian Reservation and 11,500 on the Lincoln National Forest in New Mexico last year, while about 6,700 were killed on the Coronado National Forest (Safford Ranger District) in Arizona. The New Mexico outbreak began in 1990, and the Arizona outbreak in 1991, although beetle populations may have increased prior to this.

The roundheaded pine beetle attacks and kills ponderosa pines. The outbreaks seem to be associated with high basal area stands. Although pines are being attacked in several different habitat types, damage has often been most severe in mixed-conifer stands, where the beetles have killed large proportions of the pines (at least in the New Mexico outbreak). Significant amounts of southwestern white pine have been killed in Arizona.

Other bark beetles have also been active in these outbreaks, including the western pine beetle, *D. brevicomis*, the larger Mexican pine beetle, *D. approximatus*, and *Ips.* spp.

Ground surveys conducted in the Riggs Flat area of the Pinaleno Mountains indicated significant declines in beetle populations there in 1994.

White Pine Blister Rust ***Cronartium ribicola***

This very damaging disease was first found on the Lincoln National Forest in 1990 on southwestern white pine, *Pinus strobiformis.* It is caused by a non-native fungus that was introduced to North America around the turn of the century.

We have determined that blister rust occurs throughout most of the range of white pine in the Sacramento and White Mountains of southern New Mexico. This includes portions of two Ranger Districts on the Lincoln National Forest and the Mescalero Apache Indian Reservation. Up to one-half million acres are affected. This area has the largest white pine population in the Region. Over time, the outbreak is expected to have a severe impact.

In 1994, we found rust infection on a few trees in the Capitan Mountains, an isolated range about 30 miles from the main outbreak area. It is likely that the disease spread there from windblown spores, and it is possible that it could spread to more distant ranges. So far, we have not found the disease anywhere else in the Southwest.

In areas that already have high levels of the disease, it appears that some trees are resistant. With help from the Pacific Southwest Research Station, we hope to do additional testing for rust resistance. There is interest at the Rocky Mountain Research Station in developing a rust hazard rating system and in modeling the outbreak. We are currently monitoring the outbreak with a set of permanent plots and through general observation; additional surveys are being planned.

TABLE 1. Number of trees killed and acres affected by bark beetles on National Forests and Indian Reservations in Arizona surveys covering approximately 9.4 million acres.

	Mountain Pine Beetle		Western Pine Beetle		*Roundheaded Pine Beetle		**Ips Beetles		Douglas-fir Beetle	
NATIONAL FOREST	Trees	Acres	Trees	Acres	Trees	Acres	Trees	Acres	Trees	Acres
Apache-Sitgreaves	-	-	760	735	-	-	50	155	10	50
Carson	140	130	-	-	-	-	165	125	10	125
Cibola	-	-	305	180	-	-	300	320	20	40
Coconino	-	-	1,435	190	-	-	4,430	945	510	90
Coronado	-	-	240	100	6,665	2,130	50	10	535	150
Gila	-	-	850	690	-	-	50	85	25	15
Kaibab	1,390	210	695	130	-	-	1,535	425	235	170
Lincoln	-	-	-	-	11,510	10,950	-	-	-	-
Prescott	-	-	15	5	-	-	1,220	200	35	5
Santa Fe	745	660	-	-	-	-	690	725	-	-
Tonto	-	-	270	30	-	-	1,965	345	20	5
RESERVATION										
Fort Apache			410	60			700	600	60	10
Mescalero-Apache					25,620	12,720				
Navajo	1,040	990							25	45
San Carlos			95	25			460	395		
Santa Clara	5	5								
Hualapai			115	15						
TOTAL	**3,320**	**1,995**	**5,190**	**2,160**	**43,795**	**25,800**	**11,615**	**4,330**	**1,485**	**705**

*Primarily Roundheaded pine beetle, but also includes some western pine beetle, IPS beetles, and larger Mexican pine beet

**Only includes species affecting ponderosa pine.

***Includes both Fir Engraver Beetle and Western Balsam Bark Beetle.

Table 2. Status of Other Forest Insects in the Southwest

Insect	Host	Location	Remarks
BARK BEETLES			
Mountain pine beetle Dendroctonus ponderosae	Ponderosa pine	Arizona New Mexico	While still at relatively low levels, mortality has been increasing for the past two years at some locations. The most significant activity in 1994 occurred on the Kaibab (North Kaibab Ranger District) and Santa Fe National Forests and the Navajo Indian Reservation (see table 1). About 50 acres were affected in Grand Canyon National Park.
Western pine beetle Dendroctonus brevicomis	Ponderosa pine	Arizona New Mexico	Regionwide, the amount of mortality attributed to this insect has remained virtually constant the past three years. In addition to the activity reported in table 1, it has occurred in conjunction with the roundheaded pine beetle on the Lincoln National Forest and Mescalero Apache Indian Reservation.
Pine engraver beetles Ips spp.	Ponderosa pine Pinyon pine	Arizona New Mexico	Ponderosa pine mortality increased in 1994, with about 4,330 acres affected, compared with 1,630 acres in 1993. Most damage consisted of small group mortality (2 to 10 trees), with occasional larger group kills. (See table 1). State and private lands in Coconino and Yavapai counties in Arizona also had small pockets of mortality. Damage continued on private lands east of Mt. Taylor and in the Rancho del Chapparel Girl Scout Ranch in northern New Mexico. Extensive pinyon losses occurred in housing developments in Cedar Crest, Edgewood, Santa Fe, Jemez Springs, and Raton, New Mexico.
Douglas-fir beetle Dendroctonus pseudotsugae	Douglas-fir	Arizona New Mexico	Regionwide, tree mortality continued to decrease in 1994, with about 705 acres affected. Small group mortality (2-10 trees) occurred at several locations. (See table 1).
Spruce beetle Dendroctonus rufipennis	Englemann spruce Blue spruce	Arizona New Mexico	Populations continued at low, endemic levels throughout the Southwest (see table 1).
Fir beetles Scolytus ventralis (in white fir) Dryocetes confusus (in subalpine/corkbark fir)	White fir Subalpine fir	Arizona New Mexico	Mortality increased Regionwide, with about 3,135 acres affected in 1994 compared with 2,330 acres in 1993. Much of the activity occurred on the Kaibab National Forest and Navajo Indian Reservation (see table 1). Mortality also occurred on State and Private lands in Rio Arriba county, New Mexico. Fir beetle mortality is often associated with root disease.
Red turpentine beetle Dendroctonus valens	Ponderosa pine	New Mexico Arizona	These bark beetles occur throughout most of the Southwest, usually at low levels. High numbers of them were found in 1994 in a recently thinned stand on private land near Mt. Taylor in New Mexico.
DEFOLIATORS			
Douglas-fir tussock moth Orgyia pseudotsugata	Douglas-fir Spruce	New Mexico Arizona	Populations rose dramatically in 1994 in Santa Fe, Los Alamos, and White Rock, New Mexico on ornamental spruce. A small population was detected on West Peak in the Pinaleno Mountains in Arizona, with defoliation observed in August.

Table 2. Status of Other Forest Insects in the Southwest--continued

Insect	Host	Location	Remarks
Pandora moth *Coloradia pandora*	Ponderosa pine	Arizona	No defoliation was detected in 1994.
Pine sawflies *Zadiprion* spp. *Neodiprion* spp.	Ponderosa pine Pinyon pine	New Mexico	In 1994, sawflies again defoliated ponderosa pines in Santa Fe, Cedar Crest, Manzano, and Mountainair, New Mexico. Pinyon sawfly caused complete defoliation of trees near Taos and Tucumcari, New Mexico.
Pinyon needle scale *Matsucoccus acalyptus*	Pinyon	New Mexico Arizona	Damage to landscape pinyons was common in many locations in New Mexico. A chronic outbreak of several hundred acres was observed in woodlands just north of Questa, New Mexico. Some defoliation was observed on the Prescott National Forest.
Pinyon needle miner *Coleotechnites edulicola*	Pinyon	New Mexico	Defoliation continued in woodlands on the north side of Santa Fe in 1994. An outbreak was also reported near High Rolls, New Mexico.
Ponderosa pine needle miner *Coleotechnites ponderosae*	Ponderosa pine	New Mexico	A continuing outbreak in San Miguel county, north of Las Vegas, New Mexico, was detected on about 260 acres in 1994.
Fall webworm *Hyphantria cunea*	Siberian elms Cottonwoods	New Mexico Arizona	Defoliation continued to be common on landscape and lower elevation riparian hardwoods on State and private lands throughout New Mexico.
Aspen Defoliators Large aspen tortix *Choristoneura conflictana* Western tent caterpillar *Malacosoma californicum* Marssonina leaf blight *Marssonina populi*	Aspen	Arizona New Mexico	About 9,030 acres of aspen defoliation was detected in the Southwest in 1994, compared with 17,220 acres the previous year. Damage may result from a single agent or from a combination of insect, disease, or abiotic factors.
OTHER INSECTS			
Pine tip moths *Rhyacionia* spp. *Dioryctria* spp.	Pines	New Mexico	Landscape pines, including ponderosa and pinyon pine, continued to be damaged by several species. Damage increased considerably in the Santa Fe area in 1994.
Twig beetles *Pityophthorus* spp.	Pines	New Mexico Arizona	Twig beetles continue to be a major problem on landscape pines in New Mexico. Damage was also observed in woodland and forest situations, especially near new home construction sites, in New Mexico. Scattered activity was detected on the Peaks Ranger District of the Coconino National Forest.
Cooley spruce gall adelgid *Adelges cooleyi*	Spruce Douglas-fir	New Mexico Arizona	Populations of this gall-making insect have been on the increase on ornamental and native spruce in New Mexico since 1993. Significant foliage injury was reported on Douglas-fir, the alternate host, in Espanola, New Mexico.
Prescott Scale *Matsucoccus vexillorum*	Ponderosa pine	Arizona	Branch dieback associated with this insect was noted in the vicinity of Baker Butte on the Coconino National Forest. Populations on the Fort Apache Indian Reservation were not detected from the air in 1994.

Table 3. Status of Other Forest Diseases in the Southwest

Disease	Host	Location	Remarks
STEM AND BRANCH DISEASES			
Red Rot *Dichomitus squalens*	Ponderosa Pine	Arizona New Mexico	Red rot is the most common decay of living ponderosa pine in the Southwest. The flat, white, poroid fruiting bodies are most often found on slash.
Red Ring Rot *Phellinus pini*	Douglas Fir, Ponderosa pine, Spruce, True Firs	Arizona New Mexico	*Phellinus pini* is indigenous to mature and overmature stands of pine and mixed conifers. Conks are often found on living trees.
Rust-red stringy rot *Echinodontium tinctorium*	White fir	Arizona New Mexico	The "Indian Paint Fungus" is common on mature and overmature white firs. Conks are often found on living trees.
Aspen trunk rot *Phellinus tremulae*	Aspen	Arizona New Mexico	The "False Tinder Fungus" causes considerable decay in most mature aspen stands in the Southwest. The hoof-shaped conks are often found on living trees.
Aspen stem cankers *Encoelia pruinosa* *Ceratocystis fimbriata* *Cryptosphaeria populina* *Hypoxylon mammatum* *Cytospora chrysosperma*	Aspen	Arizona New Mexico	One or more of these canker diseases are common in most aspen stands. Aspen cankers are one reason that aspen is usually a short-lived tree.
Atropellis canker *Atropellis* spp.	Pines	New Mexico	This disease is common and locally abundant on the Lincoln National Forest and Mescalero Apache Indian Reservation, but is not causing major damage. Southwestern white pine is very susceptible.
Fir broom rust *Melampsorella caryophyllacearum*	True Firs	Arizona New Mexico	This disease is widely distributed on white, subalpine, and corkbark firs. Brooms or stem-breakage can occasionally be hazardous.
Spruce broom rust *Chrysomyxa arctostaphyli*	Spruce	Arizona New Mexico	This disease is scattered throughout much of the host type, usually at low levels.
Comandra blister rust *Cronartium comandrae*	*Pinus elderica* Ponderosa pine	Arizona	This disease has been damaging to Afghan/ Mondell pines planted in the Payson, Sedona, and Prescott areas. It rarely infects ponderosa pine in the Southwest.
Limb rust *Cronartium arizonicum* *Peridermium filamentosum*	Ponderosa pine	Arizona	This disease causes progressive branch mortality, usually from the center of the crown. It is fairly common in northern and southern Arizona.
True mistletoes *Phorodendron* spp.	Junipers Hardwoods	Arizona New Mexico	These parasites may be less damaging than their dwarf counterparts because they manufacture much of their own food. However, there are many woodland and riparian areas in the Southwest that are significantly impacted. Growth loss and mortality can occur, particularly during periods of moisture stress.

Table 3. Status of Other Forest Diseases in the Southwest--continued

Disease	Host	Location	Remarks
ROOT DISEASES			
Armillaria root disease *Armillaria ostoyae*	Conifers Aspen	Arizona New Mexico	This is probably the most common root disease in the Southwest. It appears to be very widespread, and may cause significant damage in some mixed-conifer stands. It affects pine in a few locations.
Annosus root disease *Heterobasidion annosum*	Conifers	Arizona New Mexico	This disease is also widespread, and causes significant mortality in some stands.
Black Stain *Leptographium wageneri* var. *wageneri*	Pinyon pine	New Mexico	This damaging disease has been found in two isolated locations in northern New Mexico.
Schweinitzii root/butt rot *Phaeolus schweinitzii*	Douglas-fir True firs	Arizona New Mexico	This disease is common in old-growth Douglas-fir, and can predispose trees to windthrow. Old fruiting bodies of the "velvet-top fungus" resemble cow pies.
Tomentosus root/butt rot *Inonotus tomentosus*	Spruce	Arizona New Mexico	May be abundant in some stands.
Ganoderma butt rot *Ganoderma applanatum*	Aspen	Arizona New Mexico	Common in many aspen stands. Often results in stem breakage or windthrow.
FOLIAGE DISEASES			
Ponderosa pine needle cast *Lophodermella cerina*	Ponderosa pine	New Mexico	Incidence of this disease, as detected from aerial surveys, decreased from 7,280 acres in 1993 to only 600 acres in 1994, with 560 acres affected on the Santa Fe and 40 acres on the Cibola National Forests. The disease was also detected on private land in Sugarite Canyon in Colfax County, New Mexico.
Pinyon needle cast (agent not identified)	Pinyon pine	New Mexico	No significant needle cast was seen on pinyon in 1994. Damage from the 1992 outbreak which affected woodlands in many parts of New Mexico continues to be observed.
Marssonina leaf blight	Aspen	Arizona New Mexico	See "Aspen Defoliators" section of Table 2.

Biological Evaluations Completed in 1994

Through biological evaluations, our staff provides information to affected land management agencies on new or existing insect and disease outbreaks or infestations. In a biological evaluation, the specialist reports on the current status and expected population trends of the insect or disease of concern, describes resource and ecological effects of insect or disease activity and discusses alternatives for management.

In 1994, staff members from FPM conducted 28 separate Biological Evaluations **(3420 letters)** throughout the Region. They are listed below.

ARIZONA ZONE

1. Biological evaluation of potential hazard trees in Winn Campground, Springerville Ranger District. 2/94.

2. Biological evaluation of Dairy Springs and Pine Flat campgrounds fiscal year 1995 bark beetle prevention projects, Coconino National Forest. 4/94.

3. Douglas-fir Tussock Moth Monitoring in Arizona, 1993. 6/94.

4. Post-treatment biological evaluation of the fiscal year 1990 Abineau dwarf mistletoe suppression project. 6/94.

5. Biological evaluation of bark beetle caused tree mortality on the Mormon Lake Ranger District. 8/94.

6. Biological evaluation of the 1995 Promontory dwarf mistletoe suppression project, Chevelon Ranger District, Apache-Sitgreaves National Forest. 10/94.

7. Biological evaluation of the 1995 Fracas dwarf mistletoe suppression project, North Kaibab Ranger District, Kaibab National Forest. 10/94.

NEW MEXICO ZONE

1. Tree Die-Back and Mortality Near Black Mesa and Kayenta Mines, AZ. 1/12/94.

2. Proposed Bark Beetle Suppression Project, Mescalero Apache Indian Reservation. 1/20/94.

3. 1986 Western Spruce Budworm Suppression Project, Camino Real Ranger District, Carson National Forest. 1/21/94.

4. *Ips* Bark Beetles, Cuba Ranger District, Santa Fe National Forest. 1/31/94.

5. Proposed Old Burn Dwarf Mistletoe Control Project, Santa Clara Indian Reservation. 2/2/94.

6. Silver Lake Campground Bark Beetle Evaluation, Mescalero Apache Indian Reservation. 2/17/94.

7. Curtis Dam Landfill: Ponderosa Pine Sapling Mortality, Cloudcroft Ranger District, Lincoln National Forest. 5/12/94.

8. Dwarf Mistletoe Control Projects, Espanola Ranger District, Santa Fe National Forest. 5/16/94.

9. Hazard Tree Survey, El Rito Canyon, El Rito Ranger District, Carson National Forest. 5/19/94.

10. Hazard Tree Training and Evaluation, Jemez Ranger District, Santa Fe National Forest. 7/12/94.

11. Hazard Tree Training and Management at Canjilon Lakes Campground, Canjilon Ranger District, Carson National Forest. 7/12/94.

12. Borracho Dwarf Mistletoe Control Project, El Rito Ranger District, Carson National Forest. 7/25/94.

13. Dwarf Mistletoe Control Projects, Tres Piedras Ranger District, Carson National Forest. 7/26/94.

14. Allotment Timber Sale and Dwarf Mistletoe Control Project, Ramah Navajo Indian Reservation. 8/16/94.

15. Proposed Dwarf Mistletoe Control Projects, Jemez Indian Reservation. 8/30/94.

16. Ishkoten Canyon Dwarf Mistletoe Control Project, Jicarilla Apache Indian Reservation. 9/23/94.

17. Southside Dwarf Mistletoe Control Project, Santa Clara Indian Reservation. 9/27/94.

18. Tree Damage, Tunitcha Mountains, Navajo Indian Reservation. 11/28/94.

19. Dwarf Mistletoe Control Projects, Mescalero Apache Indian Reservation. 11/29/94.

20. Forest Health Project Progress Report, Mescalero Apache Indian Reservation. 12/14/94.

21. Monitoring of the La Jara Dwarf Mistletoe Control Project, Camino Real Ranger District, Carson National Forest. 12/20/94.

Publications

Conklin, D.A. 1994. White Pine Blister Rust Outbreak on the Lincoln National Forest and Mescalero Apache Indian Reservation, New Mexico. USDA Forest Service, Southwestern Region. R-3 94-2. 12pp.

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Other Entomology and Pathology Activities in 1994

Technology Development Projects

Effects of slash management practices and overstory density on Ips spp. brood production in ponderosa pine slash

In cooperation with Northern Arizona University, the Region is partially supporting two projects examining effects of slash management practices and overstory density on *Ips* brood production. The purpose of these projects is to evaluate effectiveness of cultural treatments designed to reduce risk of *Ips* bark beetle population buildup in slash following thinning. These studies are being conducted by Jaime Villa-Castillo and Victoria Wesley at the direction of Dr.'s Mike Wagner, Northern Arizona University, and Jill Wilson, Forest Pest Management, Southwestern Region. These projects will be completed in December 1995. (See Southwestern Region Forest Insect and Disease Conditions Report 1993 for more details.)

Roundheaded Pine Beetle Area Study

In September, 1994, 20 study areas each 5 acres were established to determine the effect of verbenone, an antiaggregant, on roundheaded pine beetle (RPB). The study involved five replications of four treatments: 1) control, 2) RPB bait (low release rates of both exo-brevicomin and frontalin, as determined by Lindgren trap studies), 3) verbenone [enantiomer blend (-)86%/(+)14%], 4) RPB bait plus verbenone. The bait was placed near the center of the baited treatments atop 10 foot poles. There were 50 verbenone bubble caps (PHERO TECH INC., B.C., Canada) per acre distributed evenly throughout each of the verbenone and bait plus verbenone treatments. They were stapled to the base of a tree or to stakes. Baited Lindgren traps were used to determine the timing of the fall RPB flight. The diameter breast height (DBH) and height of each ponderosa pine attacked by RPB and western pine beetles previous to the fall, 1994, RPB flight were recorded for each area. In February, 1995, areas were visited to determine the number, DBH, and attack type of fall, 1994 bark beetle attacked ponderosa pine. The average number of percent successfully attacked trees in 1993

for the control treatments was the same as in 1994. There was a 80% increase, 40% decrease, and a 9% decrease in the percent successfully attacked trees for the bait, verbenone, and bait plus verbenone treatment areas, respectively. Though these treatment averages are not statistically significant they do show a trend. The release of verbenone results in fewer attacked trees even when the area is boosted with additional bait pheromones. Also, there were two to three times more unsuccessfully attacked trees (pitch outs) in the verbenone treatments than in any of the other treatments.

Spruce Budworm Trapping in the Sacramento Mountains

During the period of June through October 1994, Terry Rogers of our New Mexico Zone staff conducted a western spruce budworm (WSB) detection survey on the Sacramento Ranger District, Lincoln National Forest, and Mescalero Apache Indian Reservation. Terry used Delta type pheromone sticky traps to estimate 1994 WSB population levels on these two administrative units. Ten plots, consisting of three traps per plot, were installed on the Sacramento Ranger District and Mescalero Apache Indian Reservation. The results indicated that WSB adult moth populations are currently at low levels on both the Sacramento Ranger District and Mescalero Apache Indian Reservation. Eight male moths were caught on the Sacramento Ranger District and six male moths were caught on the Mescalero Apache Indian Reservation. Based on these data WSB population levels are expected to remain at low levels on both of these administrative units in 1995.

Root Disease Survey and Modeling

Six stands in the Kaibab, Carson, and Santa Fe National Forests were surveyed for root disease. Each stand (from 25 to 140 acres) was 100% cruised initially to determine the number and location of root disease (mostly *Armillaria ostoyae* and mortality centers. One or two fixed radius plots (0.2 or 0.4 acre) were placed within each stand, located in an actively expanding center. The data from one stand, surveyed in 1993, and three stands, surveyed in 1994, in the Kaibab National Forest and within the Lost Canyon Ecological Land Unit, were used to run the Forest Vegetation Simulator (Prognosis) and the Western Root Disease Model post processor. The Lost Canyon Ecological Land Unit is managed for Northern Goshawk habitat. Root disease data was used to determine whether these four stands would meet habitat requirements after 100 years of disease activity. Two of the stands had previously been selectively cut while the other two had no history of cutting. A larger amount of the area in the previously cut stands (20 and 16%) and a smaller amount of the area in the uncut stands (10 and 12%) was occupied by root disease. If these stands are thinned the model projections for the number of trees in each diameter breast height category will not meet the requirement for Northern Goshawk habitat (new stumps will act as disease foci). Even if not thinned the distribution of openings may not be met after 100 years.

Establishment of Permanent Plots

In 1994, 12 permanent plots were established as part of the "Pest Trend Impact Plots in the West" technology development project. The purpose of the project is to establish and monitor permanent plots in areas affected by specific insects and diseases and use the information to validate the pest subroutines of the Prognosis growth and yield model. Two of the 12 plots were in areas infested with western spruce budworm and the other ten plots were in root diseased areas. Also, 9 dwarf mistletoe permanent plots previously established in Arizona were checked for mortality in 1994.

Two plots were established in New Mexico to monitor the intensification of pinyon dwarf mistletoe.

Aerial Detection Surveys

Over 9.4 million acres of Federal lands in Arizona and New Mexico were surveyed during July through September 1994. Forest Pest Management observers survey nearly all forested land in the Region (except pinyon-juniper woodlands) annually. Other areas, including pinyon-juniper woodlands, are flown on request. Ground examinations are often made to confirm observations. Upon completion of the surveys, maps showing the type, location, and extent of insect and disease activity are prepared and sent to the respective administrative units. Digital files are also provided to National Forests in Arizona for input into GIS. Aerial surveys are a cost effective way of detecting major forest pest activity. Done annually, they provide an excellent way to monitor changes in pest activity over time. State pest management specialists conduct aerial and ground surveys on State and private lands.

Input to Resource Management Planning

Personnel from Forest Pest Management ensure that forest health considerations are incorporated into land management decisions by providing input on forest insects and diseases and their effects on resource management to regional and forest level planning efforts as well as to numerous forest plan implementation projects, including area resource analyses, timber sales, recreation area analyses, etc.

Training

The Forest Pest Management staff in the Southwestern Region offers training to personnel from the USDA Forest Service, USDI Bureau of Indian Affairs and National Park Service, as well as other interested federal and state agencies and tribal resource management agencies on a variety of subjects related to forest insect and disease management. Three main types of sessions are offered: 1) Forest Pest Identification and Hazard Tree Management in Recreation Areas, designed for recreation managers, 2) Identification, Effects, and Management of Forest Insects and Diseases, for resource specialists who participate on interdisciplinary teams where forest insects and diseases are a management concern, and 3) Forest Insect and Disease Identification, informal sessions intended for field going personnel including markers, stand examiners etc.